The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

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The Chemical Age

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Coal—and the Chemical Industry

WE have stated in these columns on more than one occasion our belief that attention should be paid to the possibilities of founding an organic chemical industry in this country based on the paraffin hydrocarbons. America and other countries have, as their raw material, ample supplies of natural gas and refinery gases, arising from distillation or cracking. We, in this country, have little of this raw material and no petroleum. It appears, moreover, that the British petroleum industry is unwilling to embark upon an organic chemical industry. What the underlying reason is will be left unsaid here; international politics and international finance still play their part in the business world.

If the petroleum industry will not tackle this great opportunity, we must do it ourselves, using our particular raw material—coal. Two pronouncements have recently been made to this end, and it is worth while paying some attention to them. The first is a speech made to the Fuel Luncheon Club by Colonel Bristow. The Colonel, as most of our readers will know, has been identified for many years with low-temperature carbonisation. He has erected several plants, and it would not be unfair to others to say that the operations of Colonel Bristow's company are the most important in this country in this particular field, and perhaps the most far-reaching in the world. He is thus in a position to speak with some authority on the subject of possible future developments. The gases from low-temperature carbonisation are very different from town gas, and contain up to 97 per cent. by weight of methane, ethylene, and ethane. Not very much can be done with methane—even the petroleum technologists do not find it to be a promising material for further chemical operations. The yield of ethylene, however, is quite considerable. It is possible to produce some 20,000 tons of this gas from one large plant annually. There would be no particular difficulty in selling the coke, or it might be used for fuel in the works. From 20,000 tons of ethylene a very considerable quantity of organic chemicals could be produced. Colonel Bristow's address, which was contained in our issue of May 8, thus indicated one possible method by which an organic chemical industry could be developed in this country. A great deal of investigation is needed before this can be regarded as more than a possibility; commercial

On Other Pages

possibilities are not necessarily coincident with chemical possibilities. No doubt Colonel Bristow himself, who, from his status as a tar distiller, is closely associated with the A.B.C.M., will carry this project to the stage of practical application if it proves to be commercially sound.

From a different angle, the same problem has been considered by the Parliamentary and Scientific Committee. This is an unofficial body which seems to have been self-generated, and which exists for the purpose of telling M.P.s and Government Departments what they should know about scientific thought and achievements. The Committee has been trying to discover how this country stands in relation to research on coal utilisation, and so far as its inquiries go is not pleased with what it has learnt. We have made reference on previous occasions to the vast results of the research work conducted in America in the field of chemical industry, of which petroleum is only one example. Not unnaturally others are beginning to see the same things and to come to the same conclusions. If we correctly understand the Committee's main conclusion, it is that research work on coal as a raw material should be immensely stepped up. In the Committee's own words: "In the broadest sense, every investigation into the production and use of gas and electricity and of chemical products derived from coal can be regarded as coal utilisation research." The Committee expresses its deep conviction that far more than is now being done must be done to meet even the most pressing needs of a complete programme of coal research. The Committee further believe that this step is necessary in order to meet the catastrophic change in our balance of trade. A very ambitious scheme is proposed for research in which there is envisaged the employment of several thousand qualified research workers at an annual expenditure of £1000 each and a total expenditure running into several million pounds per annum.

The various methods by which the better utilisation of our coal reserves can be developed have thus been summarised by the Committee: "Transport by sea, by road and in the air should all be investigated and full-scale trials and demonstrations undertaken. We would like, for example, to see a coal-fired merchant ship built with all the refinements of modern engineering science to establish what coal can do as against oil. We would like also to see pulverised-coal-fired locomotives running to try out the possibilities of this important system of combustion. Steam wagons, producer-gas lorries, coal-gas and methane cars should all be actively developed and tested. Experimental furnaces embodying new principles of heat transfer should be installed in co-operation with the various coal-using industries. Large and small boilers should be erected to try out every new discovery that fundamental research into combustion is bound to produce. . . . We envisage a complete power station supplying electricity, but devoted exclusively to research into electrical generation. We would welcome, too, an investigation into the possibilities of district heating. The potentialities of gas grids should also be fully investigated in actual practice, and many other outstanding problems of the gas industry are of such a kind as to require exploratory plants on a large scale. A useful beginning has been made in this field, despite the limitations of war, but far more can usefully be undertaken. These are a few examples of installations which should be conceived as research projects, but built and operated in closest contact with the industries concerned."

A great deal of this work is non-chemical in the sense that it does not lead directly to the formation of chemical industries, but the Committee has prefaced this comprehensive list of suggestions by this pertinent view: "More than half (of the workers that could be usefully employed in coal research) could be assigned to the fundamental task of producing liquid fuels and chemicals from coal. The remainder could undertake the development of improved methods of releasing and utilising the energy in coal." It would appear that if the view of the Committee prevails we may be on the brink of establishing an entirely new age of organic chemistry in this country. But we must not count our research chickens before they have even been put into laboratories to be incubated.

NOTES AND COMMENTS

The Romance of an Engine

A STORY which has the same sort of flavour as a novel full of spies and counter-spies attaches to the electrolytic hydrogen engine, details of which, from a marine engineering paper, are given on another page. The engine, which is said to be used for driving German submarines, was invented by Rudolph Erren, a German who came to this country in 1930 in order to develop his ideas regarding the internal-combustion engine and to acquire British nationality. His oxy-hydrogen generator was demonstrated to the Admiralty some years before the war, but was turned down. Erren was subsequently approached by representatives of the German Government who were desirous of applying his invention to the propulsion of German submarines. Despite attractive cash offers, Erren declined to entertain the German proposals, as he was strongly opposed to the Nazi régime. Subsequently, his London office was burgled and all his private correspondence stolen, and it was later discovered, after Erren's internment by the Home Office, that a person who had been financially interested in his schemes had kept in this country a German assistant of Erren's working on his patents for a year after war broke out. This man was eventually interned by order of the Home Office. Now apparently the capture of Nazi U-boats propelled by this type of engine has caused some slight stir in Allied naval circles.

Anodising in War-Time

IN an interesting paper delivered to the Midlands Centre of the Electrodepositors' Technical Society, Mr. A. W. Wallbank spoke of the valuable properties of aluminium that has been anodically oxidised. If we were still at peace, he said, it is certain that the commercial application of anodising would have developed considerably. The corrosion resistance of the anodic film would have enabled aluminium to compete with stainless steel and plastics as a modern material while its decorative possibilities as a dyed film would have created a new medium for the artist and the architect. The formation of anodic films for special purposes, such as extreme wear resistance, reflection of light or heat, electrical insulation, and photographic reproductions, would have still further extended the anodising processes. In war the decorative uses could not be considered, but protective applications had become vital to the nation, and anodising now ranks with cadmium and zinc plating as a protective treatment of war material. At the present time almost all the aluminium which is being anodically oxidised is destined to become airborne, and therefore anodising is largely governed by the requirements of M.A.P. The Aeronautical Inspection Department approves both chromic and sulphuric acid anodising processes.

A Neglected Subject

AS a maritime nation we are accustomed to accept the phrase "The sea is in our blood" as gospel truth, yet so far as industry is concerned we have scarcely begun to realise that the oceans represent a great deal more than the theatre of operations for our Navy and Mercantile Marine. As a source of raw materials and of mechanical power the sea has long been a neglected province. It is only recently that there has been any scientific development and control of the sea's food resources, the great fisheries of the world. Dr. Delf's lecture on seaweeds was the first on that subject to be delivered to the Royal Society of Arts since Stanford, the discoverer of alginic acid, delivered an address there in 1884. That is a measure of our neglect of one small angle of the sea's vast potentialities. Mr. A. D. Cotton, who presided at Dr. Delf's lecture, said that seaweeds are really known only to botanists, a remark which is unfortunately all too true. The botanists admit the inadequacy of the studies they have made; the chemistry of seaweeds, on the other hand, is almost non-existent, the literature on the subject being almost unknown to the majority of chemists.

Seaweed and Chemistry

IT is remarkable, for instance, that until 1941 no effective steps were taken to ensure that supplies of agar-agar, for many years an essential weapon in the tracking down of disease-

carrying bacteria, could be guaranteed within the British Empire, with the result that when Japan entered the war there had to be an undignified scramble among the seaweed-covered rocks on the coasts of Britain, South Africa and New Zealand before scientists could correct this curious omission. A profitable line of chemical research has recently been opened up by Professor J. B. Speakman of Leeds with his work on the alginates that are suitable for textiles. We understand, too, that the Irish are taking steps to investigate the possibilities of seaweed not only as a raw material for a new industry, but also as a feeding stuff for stock. The name of Professor T. Dillon is associated with the most recent work in Ireland. New uses are being found to-day which offer prospects for the future. In years to come chemical products derived from plants will certainly become of increasing importance. The sea as well as the land must be considered as a basis for that branch of chemical technology, developed around plants and agriculture, which the Americans call chemurgy. It will be for the chemists to develop this industry, and that will require botanists to put "seaweed farming" on a scientific basis.

Technical Education Scheme

THE plight of the boy (or girl) who is pitchforked into an industry without guidance or encouragement is receiving attention from the Oil and Colour Chemists' Association, and their Technical Education Committee has issued a First Report, dealing mainly with a "Trainee Scheme." It is emphasised that this is a *first* report, and it purposely refrains from making any cut-and-dried recommendations. The Committee naturally have their own ideas on the subject, but they are keeping these in the background for the present: the main theme of the report is to encourage the setting up of committees with industry to consider detailed plans. To present such committees with a ready-made scheme would be prejudicial to free discussion, and the object of the report would be defeated. The great thing is that the existence of the technical problem has been overtly admitted by a body officially appointed by an industrial chemical association, and the report takes cognisance of the fact that the great influence of science of life has not yet been allowed to impinge on the average mind in the present system of general education. It will be a big step forward if that influence comes to be generally admitted in industry. The broad object of the scheme suggested is to raise the technical standard of the industries concerned, and at the same time to afford protection and assurance for trainees therein. Insistence that education should be general up to the age of 16 is a good point, and one new feature, of which more will no doubt be heard, is the suggestion that any trainee scheme should be "fluid," *i.e.*, that a trainee should be able to continue his training with another firm, should necessity arise, for example in the event of his moving his home from London to Birmingham.

RESEARCH PROGRESS

The Parliamentary and Scientific Committee has set up a sub-committee of M.P.s and well-known scientists to consider as a matter of urgency the problem of how the universities and similar bodies can help us to lead the way in post-war progress. It is suggested that there might be: (a) a short-term policy of bigger grants at once to universities and other technical training establishments; and (b) a long-term policy embracing a Royal Commission.

This sub-committee includes MR. M. P. PRICE, M.P., PROFESSOR CROWTHER, of the Institute of Physics, DR. MCCLEAN, of the Association of Scientific Workers, DR. FINDLAY, of Aberdeen, LORD HINCHINGBROOKE, M.P., ADMIRAL BEAMISH, M.P., DR. W. R. WOOLDRIDGE, and LORD PENTLAND.

CHEMICAL ENGINEERING

The Society of Chemical Industry have just published their Chemical Engineering Group Proceedings for 1941. The volume includes papers by Mr. P. Parrish on modern developments in plant for sulphuric acid concentration, Mr. E. W. Murray on ventilating blacked-out factories, Dr. G. W. Himus on economic methods of raising steam for small and medium-size boiler plants, Dr. H. J. Bush on corrosive phosphorus compounds in boiler gases, Dr. G. H. Miles on the human factor in chemical engineering processes, Mr. M. Hirsch on the condensation of water vapour, and Dr. A. Parker on the treatment of sewage and milk effluents by a system of alternating double filtration. The fourth Hinchley Memorial Lecture, by Sir Richard Gregory, is also reprinted.

British Non-Ferrous Minerals

IV.—Quartz : Sandstone : Sand

by W. H. REYNOLDS

THE investigation of quartz, sandstone, and sand, in this country today calls more than ever for special attention. Of our many domestic mineral resources, none is more abundant or more varied in quality and use, and the utility of these materials in the national economy of this country may not have been fully appreciated.

Oxide of silicon, either combined with other elements or as free silica, constitutes, according to Clark (*Data of Geochemistry,* 4th Ed., p. 33, Bull. No. 695, U.S.G.S.) 59.44 per cent. of the lithosphere. It is represented by the formula SiO_2 and its composition is: oxygen 53.3 per cent., silicon 46.7 per cent. The forms of silica dealt with herein are those occurring in the free state, such as quartz and, more particularly, silica sand and sandstone. These differ in many of their essential properties, but are all similar in chemical composition, seeing that they consist almost entirely of silica.

Quartz

Quartz is not only the most common, but is also one of the most interesting and useful of minerals. Clark estimates that it forms about 12 per cent. of the entire lithosphere. Chemically, it is pure silica. It has a molecular weight of 60.06, a specific gravity of 2.65, and a hardness of 7. When pure it is colourless, but is often tinted violet, yellow, red, green, brown, or black from the presence of slight impurities. The common acids, with the exception of hydrofluoric acid, do not attack quartz, and this property, in conjunction with its hardness and high refractoriness, is the most important property in relation to commercial value. Pure silica fuses at about 1710 ± 70° C. Before this temperature is reached, however, the quartz changes first to tridymite and then to cristobalite. The stability relations of the different crystal modifications of SiO_2 may briefly be summarised as follows:—

Inversion	*Temperature*
Quartz—tridymite	870 ± 10° C.
Tridymite—cristobalite	1470 ± 10° C.

Both of these reactions are very slow, and both are reversible.

Tridymite differs from quartz in its crystal form, refractive index, and specific gravity (2.28-2.33). Cristobalite, like tridymite, has the same composition as quartz, but is also different in its crystal form, refractive index, and specific gravity (2.27-2.34).

Sandstone

Sandstone is a rock composed essentially of grains of quartz, bound together by some substance acting as a cementing medium. The cementing material varies in different types of sandstone; thus in some it may be silica from solution, in calcareous cement, commonly calcite. Barytes, argillaceous material, and clay also often play the part of cement and occasionally thin films of iron oxide can be seen between the grains, holding them together. The sand may be made up entirely of quartz grains, or it may contain grains of other minerals, such as feldspar, mica, hornblende, magnetite, etc., in varying proportions. Sandstone ranges in colour from pure white to grey, light buff to dark yellow, brick red to reddish-brown, etc. In many cases these colours are not uniform throughout the whole mass of sandstone in any one quarry section, but may be confined to different beds, so that in one deposit it may be possible to obtain sandstone of widely varying colours. Many types of sandstone are known by names derived from the character of the bonding material cementing the grains; *e.g.*, calcareous sandstone, argillaceous sandstone, ferruginous sandstone, and micaceous sandstone are terms frequently encountered in geological and mineralogical literature.

Since silica forms such a large proportion of the lithosphere, it follows that when rocks are subjected to mechanical disintegration and chemical decomposition, the predominant mineral found in the materials of disintegration is usually quartz. The complete disintegration of a rock is generally followed by the removal of the broken-down fragments from the original site by one of the many

transporting agencies. The hardness of quartz enables it to resist attrition better than most other minerals, hence it is generally found in the form of sand. These sand grains vary greatly in shape according to the amount of erosion to which they have been subjected. Thus in some sands the grains are sharp and angular, while in others they are almost perfect spheres. They consist, in the main, of silica in the form of broken grains of crystalline quartz associated with various forms and proportions of impurities, partly impregnating or coating the quartz and partly in the form of grains or dust of other ingredients. These may be divided into two groups, the detrital minerals derived from older rocks, and the authigenous minerals which are formed at the same time as the sand was deposited. Some of the heavy detrital minerals are fixed chemical compounds, others are molecular mixtures which vary somewhat in their composition. Oxide of iron (as hematite, Fe_2O_3, or as limonite, $2Fe_2O_3.3H_2O$), "nature's colour box," acts as a coating to the mineral grains. Organic matter, such as plant remains, has the effect either of acting as a reducing agent or, in the production of humic acids, of clearing a sand deposit of impurities or rendering them more easily soluble in percolating water. Some of the purer sands, remarkable on account of the freedom of the grains from the slightest ferruginous coating, are associated with carbonaceous material. The famous glass-sand of Fontainebleau in France, Lippe in Saxony, Hohenbosch in Prussia, and Aylesbury in England, are apposite examples. The detrital minerals found in sand include magnetite, zircon, rutile, ilmenite, tourmaline, staurolite, andalusite, muscovite, kyanite, glauconite, etc.

Sand in Industry

Among the many industrial uses to which sand can be applied, one of the principal is the manufacture of glass of all descriptions, in which silica may account for between 50 and 75 per cent. of the original "batch" or "charge." It is also an important material in the manufacture of iron enamel; in the pottery industry for glaze, bedding, and other requirements; in the production of fused silica bricks, sand-lime bricks, etc.; and, finely ground, in the manufacture of sodium silicate, soap, paint, etc.

In the selection of sand deposits the most important factors, to which strict attention must always be paid, are grain size and shape, together with the suitability of screen and mechanical analyses; discoloration and the consequent impurity content; and the detrital minerals. In the past, preference has invariably been given to foreign imported sands, in particular those of Fontainebleau, where the sands are noted for their consistent quality and purity, the Fe_2O_3 content ranging between 0.0075 and 0.01 per cent., and, until quite recently, little or no systematic investigation of domestic sands seems to have been executed from the purification standpoint; nor does the application of modernised treatment which alone can enable domestic sands to become of substantial commercial value, appear to have been efficiently dealt with, *i.e.*, having regard to marketed results to-day, with the inevitable result that when materials of value for specific purposes are no longer available, as in the present war, serious delays and inconveniences are caused. Especially has this been the case in the glass industry where green-tinted glass has made its appearance on the market, the discoloration being due to the excess of iron oxide content permitted in the sand. This is attributable to the necessity for altering the Society of Glass Technology's specification, which now stands at 0.04 to 0.05 per cent. in respect of Fe_2O_3, representing pale green coloured glass, as against the maximum of 0.02 per cent. necessary essential to the production of white glass.

Regarding grain size and shape, rounded grains are considered preferable to the angular, as a more even glass melt is produced therewith. In the department of screen and mechanical analyses the Society of Glass Technology's standard for glass-making sand of good quality demands that not more than 5 per cent. shall stay on No. 36 B.S.I. sieve, and not more than 5 per cent. shall pass through No. 120 B.S.I.

Detrital minerals include magnetite—in irregular black grains; zircon—in slender prismatic crystals; rutile—as irregular foxy-red grains; ilmenite—altered to leucoxene; tourmaline—in blue and brown somewhat rounded fragments; staurolite—in golden yellow angular grains; mica—in flat flakes; biotite—another type of mica, often in

the form of a reddish-yellow paste; limonite ($2Fe_2O_3 \cdot 3H_2O$), etc. For production of high-quality glass, calcareous sands should be avoided. Titanium is always an objectionable constituent of the metal and it so happens that ilmenite ($FeO.TiO_2$) and rutile (TiO_2), like zircon, are among the most commonly occurring detrital minerals. With water-borne or air-flown sand, *e.g.*, the blown sands of the North Lincolnshire Sand Belt, the detrital minerals are spread, but in many deposits, notably Aylesbury (in association with peaty ferruginous bands); Hastings (in association with lignite); Reigate; Aylesford; Lynn and many others, the detrital minerals usually tend to congregate appreciably in cracks and joints. Those deposits or sections of them, containing sand whitened by the action of organic matter, lignite, etc., are often composed of fine grains. This is not a disadvantage, because that portion of the processed sand which may be too fine to comply with the glass standard specification, can be dealt with to produce two or more grades, namely, 36/100-mesh or 36/120-mesh, and the surplus fines can be devoted to other profitable industrial uses. Investigation of many sources of white domestic sand and soft sandstone has elicited the fact that much of the remaining impurity is traceable to the detrital mineral which, when it is appreciably of a fineness to pass 120-mesh and even 160-mesh, can be removed, thereby enabling the subsequent chemical treatment to produce results comparable with or superior to that of the Fontainebleau sands, effected with a minimum consumption of chemicals and, in consequence, at greatly reduced cost.

Refractory Sands

Refractory sands are worthy of special mention. Irregular accumulations of refractory sands and clays in hollows in the surface of the carboniferous limestones situated at Ribden and Sallymoor, in Staffordshire; and at Parsley Hay, Newhaven, Brassington, Longcliffe, and Carrington, in Derbyshire. These kaolin-bearing sands, free from alkali, lime, etc., are well known on account of their highly refractory character and are utilised in making high-quality silica bricks. Apart from the kaolin and micaceous sands, there is an abundance of quartz pebbles which, when crushed and mixed with the kaolin sand, form a valuable ganister product. Selected milky-white quartz pebbles, though the walls of cracks and joints may often be much iron-stained, can be converted into glass-sand of outstanding purity. Heat and chemical treatments, including the use of special reducing gas, is involved. The Fe_2O_3 is thereby converted into Fe_3O_4, thus facilitating its subsequent removal. A pure white sand results.

The Need for Classification

To develop and utilise domestic sands to greatest advantage, it is of vital importance that the many deposits should be carefully classified in accordance with their different degrees of purity and amenability to treatment, so that a sand which can be more or less cheaply processed to produce a material equal to that of Fontainebleau should be strictly conserved for that purpose, rather than for use as washed or unwashed sand when employed in the manufacture of the cheaper types of glassware for which a less pure sand, subjected to an economical treatment, could more than meet the demand. Likewise such classifications would prove valuable in determining the most convenient sources of supply for other industrial uses, especially where colour is not all-important and provided the impurity content, including ferric oxide, be kept within required limits. Questions of distance and mode of transport cannot be overlooked, but there are instances where treatment plants could be erected with water-way facilities. This would serve a double purpose, because those quarries insufficiently supplied with water, or with impure water, could rough-wash at the quarry and complete operations where adequate quantities of good water are available. Where a water shortage exists, some quarries settle out the clay and re-use the water. This may be satisfactory for roughly washed sand, but where chemical treatments are involved, trouble must ensue. Success is achieved mainly through careful attention to small as well as large details, as indicated in the opening article of this series in THE CHEMICAL AGE of February 13.

The present need to utilise domestic sands subjected only to a minimum treatment is said to be due to the difficulty in obtaining Government sanction for the installation of modernised processing

plant suitable for the economical purification of sand to the standard of that previously obtained from Fontainebleau and other foreign sources. This might be understandable if the contemplated installations were to be based upon the lines as apparently generally practised or understood to-day, because, owing to the high manufacturing cost per ton and the deficiencies of the product turned out, the sands produced, though acting as a palliative now, could not withstand post-war foreign competition, so that domestic sources would once again be largely discarded.

On the other hand, given the assurance that post-war competition can be successfully met, with the possibility of facilitating exports, the Government might favourably consider supporting any approved scheme to assist the domestic sand industry. Should the matter, however, be left in abeyance until hostilities cease, and imported sand returns, it may then be too late to take action on behalf of domestic sands.

Modern Plant Essential

To meet competition, a low cost per ton and a product at least equal to that of Fontainebleau sand are all-essential. For this achievement modernised plant must be installed and improved technique applied. For instance, loss of acid, say sulphuric, should be limited to the amount actually consumed by the impurity content of the sand, plus a few lb. of acid per ton of sand, lost during washing. Temperatures play an important part in this. On the mechanical side and to mention only one specific case, concentration tables, as usually operated to-day, give only 60 to 80 per cent. efficiency, whereas a much higher percentage could be obtained with these machines.

Examinations have proved that there are many and well-known domestic sand and sandstone deposits which, given the application of a higher technique, should produce results much in advance of what is obtained at present by less skilled practices. One of the most important of these, with a large estimated tonnage, is situated at Fairlight, east of Hastings, and this deposit, in fact, if dealt with by the more enlightened processing technique which is both requisite and fully warranted, could turn out a finished product equal in quality to that of Fontainebleau and delivered at consumer's own works at a competitive cost per ton. Another most important deposit is at Lochaline, Argyllshire, where improved technique could be applied with distinct advantage; others again—to mention only a few—are at Aylesbury, Aylesford, Biddulph, Reigate, and King's Lynn; and there are also sands in North Lincolnshire which would repay skilled attention.

Sand-Lime Bricks

The manufacture of sand-lime bricks, to meet the coming large post-war demand for building materials, will create a further important outlet for suitably prepared sand. These bricks are made essentially from siliceous sand and slaked lime, with sufficient water to allow the mix to be moulded under pressure, and hardened by exposure to steam. Hydrated calcium silicate is formed by the action of the steam from the sand and lime, and acts as a strong and durable cementing medium, holding the grains together. In the manufacture of sand-lime bricks too little attention has been paid in the past to essential details and factors, compliance with which alone enables first quality bricks to be made. The grading of the sand is of the utmost importance, and coarse sand should be omitted. Good results can be obtained on a basis of 40/120-mesh, plus a controlled proportion of fines passing through 120-mesh. The finer texture and smooth surface thus secured give an improved finish to the facing bricks and without the disadvantages resultant from any clay content. Calcium carbonate, which is sometimes present in sands and sandstones, likewise soluble alkalis and organic matter, should be absent. To produce high-quality bricks the sand, of which 3 tons are required per 1000 bricks, should receive the correct mechanical and chemical treatment needed, otherwise unremoved impurities will, sooner or later, be a source of trouble.

The quality of lime used is of equal importance. Ordinary commercial limes may contain as impurities varying percentages of calcium carbonate, magnesia, silica, aluminium, and sulphates, and the necessity of using only lime of adequate quality cannot be too strongly stressed, and the water used should neither contain soluble salts nor be contaminated with organic matter.

Fuel Efficiency Conference

A.B.C.M. Report

A TWO-DAY conference on fuel efficiency was held at the Institution of Civil Engineers last week. Opening the meeting, the Minister of Fuel, Major Lloyd George, described coal as *the* munition of war, and said new war fronts were bound to lead to new and unpredictable demands upon our coal supplies. The Regional Fuel Comittees had visited roughly 20 per cent. of industrial consumers burning 100 tons of coal a year or more. Waste was sometimes due to plant inefficiency, which engineers alone could remedy, but there was also waste—such as machines running when idle, and electric lights left on in the lunch hour —which could be remedied by management. " It is after all not simply patriotic management in these times but *good management at all times* to carry out this campaign against waste. For instance, the saving of fuel per ton of metal refined in the nickel industry has been about 40 per cent.," he commented.

Chemical Industry's Savings

The saving of fuel in the chemical industry was described by MR. A. J. HOLDEN, assistant manager of the Association of British Chemical Manufacturers. He said that the first difficulty in organising the fuel efficiency campaign is the heterogeneous nature of the industry. The fuel problems of a heavy chemical manufacturer are quite different from those of a tar distiller and both differ from makers of fine chemicals and pharmaceuticals. It is impossible to compare production of two such chemicals as caustic soda, and M and B 693. There is, however, a rough geographical division between the North-West, dealing mainly with heavy chemicals, the Yorkshire district, where emphasis is on dyestuffs, the Midlands, where fine as well as heavy chemicals are involved, and the South, where there is a preponderance of fine chemical makers. Three local committees were therefore formed in the autumn of 1942 to cover London and the South, Yorkshire and the North-East, and Lancashire and the North-West, and these were later enlarged to cover the Association of Tar Distillers, which is affiliated to the A.B.C.M. and has a considerable common membership. As a first step and to ensure rapid results the committee drew up questionnaires, and from the replies firms were grouped into three categories according to the urgency of the need for inspection by regional fuel experts. These groupings, notified to the various Regions through the Ministry headquarters, provided the Regions with a lead as to where they could most effectively make a start on their colossal programme of inspection. At the same time firms were grouped into three similar categories as regards utilisation and process matters.

" The North-West Regional Committee paid us the compliment of virtually turning over all inspections of member firms to the Association committee," went on Mr. Holden. " In the Yorkshire and Northern Regions the Association committee was asked to set up panels of people who would accompany the Ministry's inspecting engineers on their visits. Similar help was offered to the London Regional committee. In most cases members of our committees are also on the panel of Ministry voluntary inspecting engineers for visits to works in other industries. Our opinion is very definitely that the best results are obtained by such a system of visits and discussions on the spot. We have preferred a system of local panels rather than a single fuel efficiency officer. The three district committees cover over 224 works. While we cannot produce any definite figures for savings, we are encouraged, but by no means self-satisfied, by the results so far.

The Equipment Problem

" Visits so far made suggest that criticism usually falls under two heads—inadequacy of plant and/or inadequacy of operation. In most cases people are operating what plant they have fairly efficiently and the real problem is how much can be done to improve matters without needing licences for extra equipment. We feel that the Ministry of Fuel should have a very strong say in such matters, especially as the saving of fuel is cumulative, once equipment is installed. We are in touch with chemical plant makers and are arranging joint discussions on heat transmission which we hope may develop into special informal talks on other aspects of utilising steam and power in the construction and operation of chemical plant. From such talks may come brief technical bulletins for all members. Our panels have found cases where there is a definite need for help in the adoption of suggested improvements, and the services of the committees and panels are being offered to members to help them to put into practice recommendations made as the result of Ministry or Association visits."

MR. J. G. BENNETT, chairman of the Trade Association Sub-Committee of the Fuel Efficiency Committee, said the scope for economy in large-scale industries was in small savings spread over a large tonnage, whereas in the small-scale industries there

should be scope for large savings over a smaller tonnage. As a result of the present conference it was hoped that every branch of industry would set about constructing at their works energy balances—the most effective weapon for eliminating waste. MR. P. J. GAY, of the Paint Research Station, and chairman of the Paint Industry fuel efficiency committee, said the greatest room for economising lay in preventing waste in space heating and in planning and controlling technical operations. He urged that the campaign for economy in lighting should not be carried too far, when it might adversely affect production. MR. W. A. MOORSHEAD, chairman of the fuel committee of the Glass Delegacy and Society of Glass Technology, said his committee had prepared and circulated complete sets of lecture notes on fuels and combustion, gas producers, melting furnaces, care and use of instruments, and boilers. Lectures and individual talks with furnacemen had directly resulted in a saving of fuel.

Recording Ammeter

MR. J. L. SWEETON, of The British Drug Houses, Ltd., described the use of a portable recording ammeter to give information on load distribution. In some cases large driving units were kept running to supply only small loads, and the instrument indicated where considerable savings could be effected by suitable sectionalising. MR. H. M. PEACOCK, of Glaxo Laboratories, Ltd., said that the use of exhaust steam for power generation could affect great economies. In his own concern the equivalent of 1000 tons of coal had been saved in less than two years by the installation of back-pressure generating plant. MR. F. M. CHAPMAN dealt with the manifold uses of flash steam, and DR. E. G. RITCHIE, of the British Coal Utilisation Research Association, spoke of the increase in heat consumption and production delays caused by the wide variations in steam pressure that occur in most industrial plants. The magnitude of the peak loads could be reduced by the staggering of process units, the preheating of process water, etc. The selection of refractories and insulating materials in relation to fuel saving was considered by MR. A. T. GREEN, director of research to the British Refractories Research Association, and MR. H. HUDSON, of the Mond Nickel Co., Ltd., described the saving of fuel processes subsidiary to foundry work.

In connection with the conference a film on "Boiler House Practice" was exhibited. Produced for the Ministry of Fuel by the C.W.S. Film Unit, it had been photographed at factories in the N.W. area and included shots of a glue works, a chemical plant, and a brewery. The "actors" were the men whose job it is to ensure that the boilers are kept at peak efficiency.

NEW ADHESIVE FOR METALS

It is now possible to publish brief particulars of the Redux process, which provides, through the use of synthetic resin adhesives, a method of bonding light alloys and steel with a strength exceeding that of riveting, and of giving strong joints between metal and wood. This wide extension in the field of resin bonding opens up new possibilities in the sphere of aircraft construction and introduces new methods of assembly to the industrial designer. Its development may prove to be as significant as the introduction of the resin adhesives which, within recent years, have revolutionised the plywood industry. The Redux process enables light alloys and steel to be cemented together, or to wood, without stress concentrations, to give joints which are aerodynamically smooth, petrol-tight and stronger than comparable riveted joints.

The synthetic adhesives used in the process are unaffected by water, oil, or petrol. It works best with trivalent metals such as aluminium (dural), chromium and iron or steel and gives less satisfactory joints with brass, tin or zinc. The resin bond is mildly thermoplastic and loses strength at temperatures above 100°C. The loss of strength is, however, regained on subsequent cooling provided that the joint has not been subject to undue strain. The process, which has been devised by Aero Research, Ltd., is at present available only to firms engaged on essential war work.

CANADIAN WAR CHEMICALS

At the close of a review of the achievements of Canada's production of basic war chemicals, explosives and artillery ammunition, Harold Crabtree, president of the Allied War Supplies Corporation, told members of the Engineering Institute of Canada at Montreal that since the beginning of 1940, to fulfil the chemical explosives and munitions-filling programme alone, approximately $150,000,000 has been spent on the creation of Government-owned plants. Referring to new plants for the production of basic chemicals, Mr. Crabtree said they included four new anhydrous ammonia plants, which, he believed to have a very substantial potential economic significance for Canada's post-war economy. There were also large plants for the production of sulphuric acid. Other plants turned out hexachlorethane (a constituent of smoke mixtures), monoethylaniline, aniline oil, carbamide, phthalic anhydride, dibutylphthalate, diphenylamine, acetic anhydride, and butanol. He also noted that cellulose for war explosives, formerly provided through import of cotton linters, is now being supplied by the use of Canadian bleached wood pulp.

Chemical Products from Seaweeds

Algin as a Textile Raw Material

COMMERCIAL uses for seaweed—in the main, chemical uses—were described by Dr. E. Marion Delf in a lecture to the Royal Society of Arts on Wednesday last week. After devoting the major portion of her address to purely botanical considerations, she dealt with the gelatinous and mucilaginous materials obtained from seaweed. She said that in the last war, for instance, carrageen or Irish moss was in demand in Britain to replace gelatine which was short. The mucilaginous products could be divided roughly into two classes, with different chemical and physical properties, derived from the brown and red seaweeds respectively. From the brown algæ alginic acid is extracted by boiling the fresh material with a dilute solution of sodium carbonate; if the mass is filtered and then acidified the alginic acid is thrown as a thick slimy precipitate. When treated with vulcanising agents like carbon disulphide and carbon tetrachloride the algin* becomes a rubbery mass, which has been used to make typewriter rollers, etc.

Filament Production

By violently agitating an alkaline solution of algin with which a small proportion of tannic acid has been mixed the whole emulsifies and, when poured upon a glass or polished surface, dries to a transparent film resembling cellophane. It is claimed that this film is cheap, almost non-inflammable and less influenced by light than true cellophane, which is apt to become brittle. It has been used as an inexpensive wrapping material. Alternatively, the purified alkaline extract may be forced through a fine aperture, when it forms a viscous thread which is then spun into a bath containing a mixture of furfurol, caustic soda, formalin and other substances. By this means a kind of artificial silk is produced which, after further treatment, is washed and finally sized with an ammoniacal solution of algin under pressure. This thread, as first produced was, however, not strong enough for weaving nor sufficiently resistant to soap containing a proportion of free alkali. Further processes involving treatment of the thread with salts of chromium or beryllium are claimed to have overcome these difficulties (J. B. Speakman, 1941-1942). The chromium salts, being coloured, are not suitable for subsequent dyeing, but the beryllium salts appear to be free from this objection. The strengthened thread so obtained will no doubt be tested in due course for weaving, and Dr. Delf expressed the hope that it might soon be possible to spend coupons on some desirable seaweed fabric. The Japanese claim to have produced an artificial wool from gulfweed (*Sargassum*) by spinning the viscous thread into a bath which has a crimping effect (Tadashi Gohda, 1934). In recent years the calcium salt of alginic acid has been obtained from species of the ribbon wrack (*Laminaria*) on the Atlantic coasts of Scotland, and has been placed on the market in a form resembling pulpboard. From the same source a purified form of sodium alginate has been marketed, for use in a variety of industries, including food production, medicines, and the manufacture of cosmetics, textiles, transparencies, and plastics. Added to milk prior to drying, alginates can be used to make milk powder more soluble, and they can be similarly utilised with cocoa.

The chemical constitution of alginic acid is interesting. Recent work has established that it is polymer of *d*-mannuronic acid (Barry and Dillon, 1940). Experiments of Bonniken (1937-38) appear to indicate that treating the alkaline salts with astringent agents causes a progressive polymerisation of the original algin molecule, giving longer and more complex chain structures, which are important for the production of textile threads. The long-chain molecules are susceptible to contraction and give the possibility of a crimping effect.

Agar-agar

The greatest part of the world's supply of agar came from Japan, but it is now manufactured in Britain and California, while the rich coastal flora of S. Africa, New Zealand, N. America, and Canada offer possible new sources. To extract agar the fresh weeds (*Gelidium*) are bleached in the sun, a process which is hastened by sprinkling with fresh water at intervals. They are then boiled with water (Japan) or treated with steam (America) and the resulting mass is strained through cloth. The clear liquid is allowed to set in shallow troughs, and the jelly is then cut into narrow strips.

The most suitable supplies of weed in Britain could be obtained from the west and south-west of England, and the west and north-west of Scotland. It would be necessary to "farm" the seaweed crop on scientific lines, so that the stocks should not be depleted. Commercial utilisation requires much work on the biochemical and technical sides before the final stages of marketing the products can be reached.

* Algin was the name originally given to alginic acid by Stanford (1862); nowadays the commercial term "algin" is used to signify sodium alginate.

Imperial Chemical Industries, Ltd.

Annual Report and Chairman's Address

THE directors of Imperial Chemical Industries, Ltd., have again circulated among the shareholders the chairman's address with the annual report and balance sheet, and the sixteenth ordinary general meeting of the company, which will be held at Nobel House, Buckingham Gate, London, S.W.1, on May 27 at 12 noon, will be purely formal.

In his statement as chairman, Lord McGowan reports that Lord Glenconner, chairman of C. Tennant and Co., Ltd., has been appointed a director. The intensification of the war during 1942 has raised to still higher levels the pressure of demand on the factories, which worked at full capacity throughout the year. The plants generally were giving output well beyond usual rated capacities, and these circumstances, combined with a scarcity of men and materials, were imposing a strain on their equipment. The company was accumulating a heavy bill for deferred maintenance for which due provision was being made out of revenue, while it is considered wise to raise the appropriation to the Central Obsolescence and Depreciation Fund from £2 million to £2½ million. In addition to a number of sub-subsidiaries, two of the operating group companies—I.C.I. (Rexine), Ltd., and I.C.I. (Salt), Ltd., have been placed in liquidation.

Research and Development

Dealing with research and development, Lord McGowan continues: "We are convinced that British industry must be prepared to invest much more generously than in pre-war days in research and development. For years past we have spent considerable sums, but we are at the present time considering a marked post-war expansion of the company's scientific staff, its laboratory accommodation, the necessary experimental engineering shops and all other branches of this work. We have a substantial interest already in the plastics industry and beyond that we have in our large and able research organisation the surest background for further development in this expanding branch of production. Much is expected of plastics, but we must keep a sense of proportion and recognise that the development of these new materials in large volume and variety, at competitive prices, will take time."

"The numbers of both workers and staff in the company's employment, in which I include those in the Agency Factories which we manage for the Government, again show substantial increases during 1942," goes on Lord McGowan. "Many of our leading technicians and scientists have been seconded for service with the U.S.A., Canada, Australia, and Africa to assist in their war production. Specialists from I.C.I. have also been called upon to carry out missions to Russia, China, Central Asia, Malta, and elsewhere. In all, 2500 of our staff, foremen, and technicians have been placed at the disposal of Britain and the Allied Nations for these purposes. On December 31 last year 12,000 of our employees were serving in H.M. Forces."

Private Enterprise Unequalled

"The post-war future," Lord McGowan concluded, "is clouded with uncertainty for everyone. Of only one thing can we all be sure—that for some years conditions for trade and industry will be subject to varying measures of State control. In drawing the line between public and private enterprise I would emphasise the truth that whatever measure of international co-operation may be achieved in the future, no instrument of progress and prosperity has yet been found to equal private enterprise in originality, celerity or accomplishment. Industry, therefore, has to look to its own organisation in order that by discussion and consultation its views may be effectively presented."

The consolidated accounts show the combined assets, liabilities and income of I.C.I., Ltd., and 96 subsidiary companies. The total gross income £22,182,000 compared with £19,956,000 for 1941, the increase being ascribed to the expansion of the company's activities. The net consolidated income for the year has risen from £6,243,000 to £6,873,000, an increase of £630,000, after providing £2,500,000 for the Central Obsolescence Fund, as already stated. The estimated total National Defence Contribution and Excess Profits Tax, both British and overseas, exceeds £7,200,000. The surplus of combined assets over combined liabilities and share capital rose from £15,916,000 to £16,622,000 during the year. In addition to the £2,500,000 provided for the Central Obsolescence and Depreciation Fund of Imperial Chemical Industries, Ltd., the subsidiary companies provided in their own accounts £1,117,000. Assets consisting of investments, debts and stocks in enemy or enemy-occupied territories have all been reserved against in full. The General Reserve remains unchanged at £12,000,000; the War Contingency Reserve has risen by £250,000 to £2,750,000; the War Personnel Reserve is £100,000; and the Central Obsolescence and Depreciation Fund has risen by £1,350,000 to £8,240,000.

Low-Temperature Drying

Vacuum Drums and Shelves

MODERN vacuum dryers enable chemical manufacturers to dry their materials with a degree of safety, certainty, and economy of time and labour, which a few years ago would have been almost impossible. The safety of vacuum-drying lies in the fact that materials can be dried under vacuum at much lower temperatures than are possible under atmospheric conditions. With vacuum-drying the boiling or vaporising point can be kept down to any required temperature; for it is possible to dehydrate some delicate materials, where necessary, at temperatures as low as 25°C., the temperature at which the moisture evaporates depending upon the degree of vacuum in the dryer. In this way all danger of overheating is removed. Vacuum-drying has the advantage over the method of passing currents of heated air over the substance, because there is no danger of contamination. In atmospheric-drying another difficuly is oxidation; this also is avoided by use of vacuum drying.

The positive advantages of vacuum-drying lie in the fact that it is accomplished at a pre-determined temperature, which is practically under absolute control at all times. In the absence of air, drying becomes independent of atmospheric or climatic conditions; consequently, changes in humidity and other atmospheric variations do not affect the uniformity of the dried material as it leaves the dryer. Vacuum drying is economical because of its rapidity, for materials give up their moisture much more rapidly under vacuum and are, to-day, being dried in a fraction of the time formerly required. The process requires less floor space, while labour, fuel, and power costs per unit of dried product are all lower.

Materials that usually require drying may be separated into three groups, for each of which special types of dryer have been devised. The first group includes liquids of all sorts, the second contains materials that must be spread out in flat pans or trays during drying, and the third group includes substances that require agitation during the drying process.

Drum Dryers

Vacuum drum dryers, used for the first group, consist in general of a vacuum chamber with a hollow-heated revolving drum, equipped with devices for applying the liquid to the drum and removing the dry material. In a standard type of drum dryer the liquid to be treated is pumped from the bottom of the casing to a pan under the drum. The drum, as it revolves, receives a coating or thin film of liquid, the thickness being regulated by a spreader which also serves to break up any bubbles, leaving only a uniform coating of the desired thickness. By the time the material reaches the scraper, which removes it, the moisture has evaporated and the material is taken off in a dry state. While the drum-drying process was long ago recognised as the ideal method of drying liquids it failed to give satisfactory results because the liquid began to foam under vacuum, so preventing the production of a uniform coating on the drum. Where the drum dips or is partly submerged in the main body of the liquid it is impossible to maintain a constant level due to the oscillation and ebullition that takes place. This change in level makes a corresponding change in the amount of drum surface dipping into the liquid and results in an uneven coating on the drum and a lack of uniformity in the dry product. These difficulties have been overcome, however, by special devices for controlling the liquid supply and applying the liquid to the drum. In such devices foaming viscosity and other characteristics of the liquid do not affect the drying or the quality of the dried product because the drum is entirely clear of the body of the liquid.

Shelf Dryers

Vacuum shelf dryers, used for materials which must be spread out while drying, normally comprise a vacuum chamber containing a series of shelves, on which the loaded pans or trays of material are placed. The shelves are hollow and are usually made of steel plates joined by seamless welds. They are heated either by steam or hot water. The shelves are carefully made so that they are perfectly level and have a flat, even surface when placed in the chamber. If this were not the case the bottom of the pan containing the material would not make good contact with the heating surface of the shelf at all points and, due to the vacuum, very little heat would be transmitted to the material at points of non-contact. A serious difficulty with improperly constructed shelf dryers is the trouble caused by the strain on the manifold due to the expansion and contraction of the shelves, which frequently break the connecting joint and sometimes even the manifold itself. To overcome this trouble manifolds are usually made of special steel pipe, and in some designs the manifold is held at only one end instead of at both, an arrangement which leaves the other end of the manifold free to swing and permits the free expansion and contraction of the shelves without throwing any strain on the pipe connections between the shelves

and the manifold. The use of ground joints in the union connection between the manifold and shelves eliminates all gaskets and flanged connections. Shelf dryers of this type are suitable for drying a great variety of materials including sheet and reclaimed rubber of all kinds, rubber compounds, paints, dyes, extracts, pastes, glues, soaps, salts, albumens of all descriptions, starch, rosin, vegetables, fruits, sugars, small electrical apparatus, plates, chemicals, various by-products, and a great variety of food products.

The third group of materials, those requiring agitation during the drying process, are best dealt with in *the rotary dryer*, which generally comprises a steam-jacketed cylindrical shell, in the centre of which revolves a hollow-heating tube carrying arms and stirring paddles. The central tube and outer jacket are supplied with steam, and the space between the central tube and the jacket is the vacuum chamber, containing the material to be dried. The material being treated is kept in constant motion by the paddles. Materials handled in this dryer include many liquids and semi-liquids, solids in granular form, starch and other cereals, various by-products, fertilisers, dextrine, reclaimed rubber, and rubber compounds. Cooking or digesting operations, where required, can be performed in the same apparatus before creating the vacuum, thus saving handling.

A CHEMIST'S BOOKSHELF

THE B.D.H. PRICED CATALOGUE OF LABORATORY CHEMICALS AND TESTING OUTFITS. (Revised Edition). London: British Drug Houses, Ltd. Pp. 243.

A revised edition of the B.D.H. priced catalogue of laboratory chemicals, analytical reagents, indicators, stains, bacteriological media, and testing outfits, an important publication last issued in November, 1940, has just appeared. As far as present conditions allow the prices have been brought up to date throughout, while the later sections of the catalogue, dealing with reagents for clinical analysis, and the standard discs and reagents employed in conjunction with the Lovibond Comparator, have also been rearranged so as to present a clearer record of the solutions available and to enable any one of them to be found more easily. The present edition comprises nearly 6000 different products, and all prices are calculated on a net basis. They are without engagement, and are subject to market fluctuations and to alteration without notice. A few articles are subject to Purchase Tax, but this tax has not been included in the printed prices. In view of paper restrictions there is to be no general distribution of the list, but copies may be obtained without charge by established laboratories and professional chemists on request.

WORKED EXAMPLES IN PHYSICS. By Dr. L. J. Freeman. London: Hutchinson. Pp. 182 and index. 6s.

This book, by a lecturer of Chelsea Polytechnic, is intended for the embryo scientist who is studying for his Inter B.Sc. It contains 200 graded examples illustrating the use of formulæ fundamental to the study of elementary physics. These formulæ are conveniently tabulated under Heat, Light, Sound, and so on, a feature which mathematicians usually include in their text-books but which is too often omitted from books on physics. It seems a useful book, particularly for evening class students. During the war the difficulties of part-time study have increased and the book is therefore doubly valuable at the present time.

PLANNING OF SCIENCE. London: Association of Scientific Workers. Pp. 123 and index. 2s. 6d.

This booklet contains the proceedings of the January conference of the Association of Scientific Workers. As all the speeches then made were strictly relevant to the central theme of the conference they make an interesting and readable little book. Sir Robert Watson-Watt, the Association's president, has written an entertaining foreword in which he coins the term "planned sporadicists" to describe the declared anti-planners, and suggests that if they "can lead a crusade under that piebald banner (of planned sporadicism) they will at least advance a gaiety to which they have already made notable contributions." "Hot baths for Dr. John R. Baker" having been one of the best quips of the conference, we are not surprised to find Sir Robert saying, with tolerant sarcasm, that he himself believes in the inspirational value of hot baths, a palpable dig at the author of "The Scientific Life." Incidentally, we note that Professor P. M. S. Blackett's own remarks on the same topic, which caused a great deal of amusement when spoken, have not found their way into print. It seems a pity when scientists censor their own rather rare jokes! The booklet provides a handy record of the important speeches made by Sir Stafford Cripps, Sir Alfred Egerton, Col. Devereux, of High Duty Alloys, Sir Lawrence Bragg, Professor Blackett and Dr. C. D. Darlington, and it is illustrated with a number of excellent photographs of the speakers as well as of their audience, though some of these have not printed too well. The charts showing the organisation of Science in Britain, U.S.A., and Russia are also a welcome feature.

An Electrolytic Hydrogen Engine

Its Use in German Submarines

THE examination of captured Nazi U-boats by Allied naval authorities has resulted in a report that "the usual electric motors, supplied with current from a large battery installation, have been discarded. Instead, the main diesel engines intended for propulsion on the surface are designed to run also on a mixture of oxygen and hydrogen so that, operating with a closed exhaust, they can be used for driving the vessel when the latter is submerged" It is claimed that this Erren engine, as applied to submarines, increases the radius of action, the space available for armaments, and the speed and angle of submersion, in addition to which it eliminates the possible generation of poisonous fumes from the batteries. Moreover, it also provides the locomotive power for a trackless torpedo which, even if it misses, will give no visible indication to the enemy that it has been fired.

The Erren submarine is driven on the surface by alternative-fuel engines running on oil and driving a small high-speed dynamo which delivers its current to a high-pressure electrolyser by means of which water is broken up into hydrogen gas and oxygen gas in the ratio of 2 to 1 (H_2O) under a pressure of 3000-5000 lb./sq. in. These gases are stored in separate lightweight high-pressure cylinders along the keel. When the submarine dives, the Erren engines are switched over to run on oxygen and hydrogen without any air or oil. The combustion product of these gases is steam, which is put back into the engine at a temperature slightly above the saturation point. Oxygen and hydrogen in the correct ratio and in an amount according to the power output required are injected into each working cylinder separately; the latter is thereupon filled up with the steam and the resultant mixture is fired by means of a spark. The heat generated then superheats the steam, which expands in the usual way and drives the piston.

Experiments in Britain

A considerable amount of experimental and research work in connection with the Erren system was carried out at the works of William Beardmore & Co., Ltd., at Dalmuir. The test unit was a 10-year-old single-cylinder Beardmore engine in which the original compression ratio of 14.8 to 1 had been reduced to 10 to 1. Official tests attended by Government representatives included demonstrations of starting on air and hydrogen, changing over to oxy-hydrogen with closed exhaust, changing over to fuel oil and hydrogen and to fuel oil alone, and manœuvring at different speeds on various fuels. Demonstrations were also given of the Erren system applied to National single-cylinder diesel engines and to a Beardmore engine in a Leyland 32-seater bus. A remarkable increase in efficiency and output was a feature of these tests. It is claimed that the application of the Erren system to a submarine makes it possible to increase the radius of action to more than 15,000 miles, while the saving in weight allows the pressure hull to be strengthened to such an extent as to enable the boat to crash-dive at a steep angle and to submerge with safety to a depth of 600 ft., *i.e.*, far below the depth at which the normal depth charge is effective.—*Shipbuilding and Shipping Record*, 1942, *60*, 21, p. 495.

Eire's Mineral Deposits

Developing Avoca Ores

POINTS brought out in the first operational report of the Minerals Exploration and Development Company include details concerning the production of raw materials for superphosphate fertilisers, on which the company has been concentrating since its incorporation in 1941. Mining leases have been made available in County Clare for portions of the phosphate deposit not being worked by the Clare Phosphate Company. Open quarry and mining methods are both being employed, and by the end of last year there was a steady output of 300-400 tons weekly.

Considerable quantities of ore to replace imported ore for sulphuric acid manufacture have been secured. Avoca ore suitable for use in hand-fired kilns has been found to burn with a facility equal to that of Spanish ore, but in some sections the ore is too soft for kilns and the sulphur content low. In the Magpie section the ore, of excellent milling grade, carries a small percentage of copper, lead, and zinc. In the Blue Borrows section, never previously worked, a large tonnage of milling ore is available. It is considered that, even at reasonable peacetime prices, the scheme at Avoca should be a sound commercial project for marketing sulphur ore, as well as copper, zinc, and lead concentrates. Yellow ochre caught in settling ponds, has been obtained from the old levels at Avoca, and sold locally; while iron ore exposed near Redcross, Co. Wicklow, has averaged from 50 to 60 per cent. metallic iron.

New Industries for Wales

Plastics, Petrol, and Light Alloys

SOME stimulating suggestions for post-war industrial development in South Wales are made by Dr. W. Idris Jones, head of the research department of Powell Duffryn Associated Collieries, Ltd., in an article in the *Western Mail*. Here are some extracts from Dr. Jones's article:

"Let us first consider the factors governing the erection of a synthetic oil plant. There are three ways in which oil can be obtained from coal—by carbonisation, by hydrogenation, or by synthesis. In carbonisation the main product is coke, for which a market must be found. It must be realised that the coals suitable for hydrogenation in South Wales are limited in quantity, and are confined to the southern and eastern rims of the coalfield. For the production of oil from coal in South Wales the synthesis process appears most suited.

"Those of us who are involved in the study of coal and its application to many uses would welcome the extension of the calcium carbide plant that is already operating in South Wales, and to see the conversion of calcium carbide to acetylene, and that in turn to solvents, synthetic rubber, plastics, etc.

"The age of plastics has arrived and the possibilities in this field are enormous; the raw materials for plastics are available or can be made available in South Wales. Obviously, too, a great deal can be done in the extension of the paint industry based on plastics and synthetic solvents derived from coal.

Chemicals from Oil

"The oil refineries in South Wales should be extended and a chemical industry should be based on the refinery by-products. A great deal has been done in the U.S.A. and could be done in South Wales. Vegetable oil refining and seed crushing might also be developed to provide oils for blending with lubricating oils. Imperative, too, is the extension of the magnesium and aluminium alloy works now operating. These are a challenge to steel and the Americans have already coined a name, the Magal Age, for the light alloy era ahead of us. Beryllium, the metal that never tires, lithium, and other rare metals are, as the war has shown, of incalculable significance to engineering. It can be said that, from the research standpoint, Wales is already to the fore in this important work.

"Another important field of work is in the production of synthetic ammonia and methyl alcohol, with coal as the raw material, and with the possible production from these two compounds of the urea and formaldehyde needed to make certain kinds of plastics."

War-Time Anodising

Comparison of Processes

ONE of the most interesting parts of Mr. A. W. Wallbank's paper on "Anodising in War Time," to which general reference has been made in our editorial columns this week, was his summary of the more obvious advantages of the two differing types of process. He said that the *Bengough-Stuart Chromic Acid Process* produces thin films of the order of 0.0001 inch with little loss of metal or dimensional change in the article anodised. It is a batch type, tending to ensure correct treatment because operational details are carefully specified. The residues of electrolyte are not harmful and are readily apparent; hence the A.I.D. instruction that this process must be used for folded joints. The use of high voltage assists the throw into deeply recessed articles and enables greater liberties to be taken with suspension of work than is possible with sulphuric processes.

The *Sulphuric Processes,* on the other hand, are simpler and shorter, being worked at a constant voltage lower in value than that required for the Bengough-Stuart. The anodic films are thicker, being of the order of 0.0004 to 0.0006 inches. The processes can be used to anodise high copper-containing alloys such as D.T.H. 424. These films can readily be sealed and do not need reinforcement with organic protectives. The process is more analogous to electrodeposition in that the properties of the resultant film can be governed by controlling the treatment conditions, including concentration, temperature, current density, and time of treatment. The ability to produce a thick and transparent film, the properties of which can be modified at will, is the essential reason for the wide sphere of application of the sulphuric process. A war-time example of anodising for colour is provided by the black matt surface applied to air-screw blades, so that reflection shall not interfere with the pilot's vision.

Boliden Gruv A/B reports for 1942 that the larger part of the plant constructed in accordance with Government requests for increased copper production and treatment of lead and nickel minerals has been completed. The speeding-up of construction work caused special problems, and higher copper prices have, therefore, been granted to the company. An annual output of 18,000 tons of copper is expected. The production of nickel began in 1942. The lead mines at Arjeplog, in Swedish Lapland, are also in operation, and the lead production is about 15,000 tons per annum.

Wheat for Alcohol Production*

American Problems Investigated

FEW of the grain distilleries in the United States have had much experience in the production of ethanol from wheat. Before the conversion of the industry to an industrial alcohol basis, the three principal grains processed were maize, rye, and barley, but it has now become desirable to produce as much industrial alcohol from wheat as possible. The existing capacity for the production of absolute alcohol in the U.S.A. is 524,000,000 gallons a year, assuming that molasses will be supplied to those plants not yet converted to grain. The requirements of ethanol for 1943 have been estimated by the War Production Board at 534,500,000 gallons, and conversion of all alcohol producers will provide a capacity of about 657,000,000 gallons. The production of 534,500,000 gallons of alcohol requires approximately 220,000,000 bushels of grain based on an average grain alcohol yield of 2.42 gallons of absolute alcohol per bushel. A modern distillery should obtain 2.6 to 2.7 gallons. The problem of the wheat surplus has become extremely critical, and industrial alcohol production from wheat is a partial solution in that by this means a surplus commodity is used to alleviate a shortage of an essential chemical. Laboratory tests have been carried out, and after evaluating the results of these it was arbitrarily decided that wheats yielding over 5½ proof gallons of alcohol per bushel (dry basis) under the experimental conditions would be satisfactory for alcohol production. This is in comparison with alcohol yields of from 5.9 to 6.1 proof gallons per bushel, dry basis, with maize under similar conditions.

Commercial Production

In October, 1938, commercial tests of wheat mashing were made, and at that time the plant running the tests was equipped only for atmospheric cooking. The test was run with Soft Red Winter wheat as 91.8 per cent. of the grain bill and 8.2 per cent. wheat malt. Cooking the wheat to 100° C. resulted in poor yields, but atmospheric mashing at 68° C. produced yields of 4.75 to 5.02 proof gallons per bushel (wet basis), or approximately 5.4 to 5.75 dry basis (assuming composite moisture of 12 per cent.). These yields compare favourably with those obtained in the laboratory tests. Early in 1942 further experimental work was conducted in the Louisville plant. Three different grain bills were tested in order to obtain comparisons with different levels of rye malt as contrasted with wheat mashed with 7.05 per cent. distiller's barley malt, and it was apparent that 12 per cent. rye malt or 7.05 per cent. barley malt was equally satisfactory when contrasting the actual yields obtained. A yield of 4.9° proof gallons per bushel (wet basis) is a reasonable comparison with yields of 5.60 and 5.67 (dry basis) obtained with the same type of wheat in the laboratory. A run with which 9.00 per cent. rye malt was used for conversion, yielded slightly poorer results. Since wheat has a Lintner value of above 40°, and the starch-converting power is recognised, it was believed that a large part of the conversion malt could be eliminated by the use of wheat, and laboratory studies were undertaken.

Good yields were obtained with two and three per cent. barley malt, but one per cent. barley malt resulted in a definitely lower yield. It was noted in the course of this work that the maximum yield under the test conditions was obtained only when fermentation proceeded for at least 72 hours. Mashes prepared with higher malt concentrations normally ferment to completion in 64 hours. Since the laboratory results of the test were good, a plant trial was conducted, and it was found necessary to modify the mashing procedure to conform with equipment and operating schedules. The data indicated that only a slight reduction in yield occurs with wheat substituted for 36.3 per cent. of the maize in a normal spirits mash, and that wheat may replace over half the barley malt required for conversion with reasonable success if fermentations proceed for at least 72 hours. These are both important points, the latter because of the cost of barley malt and possible shortages due to conversion of industrial alcohol plants to a grain basis.

Processing Problems

Certain problems arise in connection with the use of all wheat for alcohol production. Foaming during fermentation makes it imperative that fermenters be operated at reduced capacity. This problem is minimised by employing not more than 40 per cent. wheat in the grain bill, the remainder consisting of maize and barley malt. The seriousness of the problem depends on the equipment of each plant. It has been found that efficient by-product recovery of wheat stillage from high percentage mashes (80-90 per cent.) is difficult with conventional equipment. Evaporator tubes foul more readily, and the highest average dryer house yield obtained with wheat was 14.4 lb. of dried grain per bushel of grain mashed, as contrasted with 17.0 lb. from maize mash.

* From an article by W. H. Stark, P. Kolachov and H. F. Wilkie in *Ind. Eng. Chem.*, February, 1943, p. 133.

This problem is greatly reduced when mashing relatively low percentages (35-40 per cent.) of wheat mixed with maize. Additional experience will probably tend to solve this problem, at least partially. The problem of by-product recovery obviously does not apply to those plants not equipped for dried grain recovery.

The types of wheat best suited to alcohol production are White or Soft Red Winter. The starch content of wheat is a trustworthy index of the expected yield of alcohol. The yields from wheat are generally lower than yields from maize, the difference being about 0.2 proof gallons per bushel. Higher yields of alcohol can be obtained from wheat, either by pressure cooking (batch or continuous processes) or by atmospheric mashing at 68°C., or from mixed grain bills of maize, wheat, and barley malt. Further research is obviously required in order to utilise wheat efficiently as a raw material for alcohol production, and to minimise the operating problems.

Parliamentary Topics

Reclaiming Used Oil

Major Lyons asked the Minister of Fuel and Power what steps he was taking, in the interests of economy, to collect and reclaim all residual and waste oils. Major Lloyd George replied that the collection and reclamation of used lubricating oil was coordinated by the Lubricating Oil Pool of the Petroleum Board. A number of refineries for the treatment of used oil were in operation. Where large quantities of lubricating oil of a particular quality were used it was more economical for consumers to filter their used oil for re-use and a large number of licences for the acquisition of filters have been issued. In other cases waste oil was being used for the manufacture of greases and low grade lubricants. Large industrial consumers had been informed of the need for economy.

Joint Production Committees

The Minister of Production was asked by Mr. Mander whether he would give an assurance that the advisability of continuing in peace-time, joint production committees, as a permanent part of our industrial system, is receiving active consideration. Mr. Lyttelton replied that these committees were voluntary bodies established by agreement between employers and workpeople. "I am sure that in the light of the experience gained their continuance after the war will be given the closest consideration by the organisations directly concerned," he commented. Mr. Mander then asked whether there was any possibility that these bodies would be continued after the war so far as the Government have any influence in the matter. Mr. Lyttelton: "They are voluntary bodies and the initiative must lie with industry." Mr. Mander: "Does the Minister suggest that there is any question of abandoning these most useful institutions?"—Mr. Lyttelton: "I made no such suggestion."

Highland Electric Power

Industrial and Parliamentary Comment

THE importance of the Hydro-Electric Development (Scotland) Bill in the development of the electro-chemical and electro-metallurgical industries in this country was stressed by Mr. S. J. L. Hardie, chairman of the British Oxygen Co., at the recent annual meeting of the company. The foundations of these industries, he said, were dependent on cheap and continuous hydro-electric supplies, and it was to be hoped that the North of Scotland Hydro-Electric Board, to be set up under the Bill, would do everything to establish electric power supplies on a basis which would ensure the introduction of the electro-chemical and electro-metallurgical industries in Scotland.

Meanwhile in Parliament the Bill is being considered in committee. In response to a suggestion of an amendment to Clause 10, providing restrictions on the use of land from the point of view of preserving the amenities, Mr. Johnston urged that the Government had gone to greater lengths in this Bill towards preserving the amenities than ever before, and the amendment was withdrawn. Another suggested amendment (to Clause 10) drew from the Government the categorical assurance that the regulations would contain a provision that the Board would not supply electricity to large power users within the area of supply of other authorised undertakers at a price less than would be offered to such authorised undertakers. Sir Arnold Gridley moved an amendment providing that the powers of Clause 18 (acquisition of undertakings by agreement) should not be exercisable in respect of an undertaking which might be purchasable by an authorised undertaking already in existence. He complained that the clause cut across and limited the statutory powers of the Grampian Company and permitted competition for the acquisition of undertakings within that company's area. Mr. Johnston said that Parliament had never implied that the Grampian Company or anyone else should possess a monopoly, and it would be improper to bind smaller undertakings to sell to that company. The amendment was defeated by a large majority. A Government amendment, that electricity supplied by the Board to authorised undertakers should be supplied by them in turn to consumers without added profit, was agreed to.

Flame-Resistant Resins

Formation of Inorganic Crust

CONDENSATION products of chlorinated tricresyl phosphate with aromatic compounds containing reactive hydrogen are flame-resistant resins suitable for use in coating and impregnating compositions. The reaction is general for alkyl-substituted aryl phosphates containing reactive halogen in the alkyl radical, but the examples given by The British Thomson-Houston Co., Ltd., in their B.P. No. 524,510 refer to a chlorinated tricresyl phosphate chlorinated in the side chain at least, this phosphate being the most readily available of the group. Chlorination may be carried out by slowly bubbling chlorine for 9 hours into tricresyl phosphate vigorously agitated at about 150°C. under mild ultra-violet light. This gives a viscous yellow oil of the preferred chlorine content. It is useful to introduce halogen into the benzene ring as well as into the side chain, because ring halogen is unaffected by the subsequent condensation and is retained in the resinous condensate, whose flame-proofing qualities are correspondingly improved.

Cable Protection

Almost any compound having at least one benzene nucleus containing reactive hydrogen will react with the halogenated ester, but heavily substituted ring compounds react less readily than others so their use is not recommended. Benzene and toluene condense with chlorinated tricresyl phosphate to give, in general, rather soft, sticky resins. Harder resins, some of them with a non-tacky or even waxy finish, may be obtained from naphthalene, anthracene, diphenyl, triphenyl phosphate, and tricresyl phosphate.

The reactants are condensed by heating with a small amount of condensing agent, preferably ferric chloride. With a chlorinated tricresyl phosphate containing 20-25 per cent. chlorine, the most satisfactory proportions are 1 part by weight of phosphate to at least 1 part, but not usually more than 2 parts, of aromatic compound. A brown, fusible, flexible resin, said not only to be flame-resistant but also to have good resistance to oil and water, is made from 200 parts chlorinated tricresyl phosphate (20-25 per cent. chlorine), 83 parts tricresyl, 127 parts naphthalene, and 2 parts ferric chloride by heating at 150°-200°C. for about 4 hours, or as long as is necessary for evolution of practically all the hydrochloric acid formed by the reaction. Excess naphthalene may then be removed by blowing the melt with air or nitrogen. This resin is stated to be soluble in benzene, toluene, chlorobenzene and triaryl phosphates, insoluble in petroleum and vegetable oils at ordinary temperatures. It is suggested as a cable impregnant.

From 200 parts of the same chlorinated tricresyl phosphate, using 2 parts ferric chloride as condensing agent, various other condensation products are obtained; with 300 parts monochlorodiphenyl as the second reactant, a thermoplastic, dark brown, waxy resin is produced which, molten or in solution, can be used for flame-proofing covered wires or cables; with 300 parts triphenyl phosphate, a very sticky, brown syrup suggested as a flame-resistant adhesive; with 300 parts diphenyl, a rather brittle, dark brown resin which can be plasticised with tricresyl phosphate or with coal-tar pitch and used as a cable impregnant; with 300 parts *o*-cresol and only 1 part ferric chloride, a red, hard, thermoplastic resin, easily fusible, recommended as a flame-resistant impregnant for wood, paper, etc. All these resins are made by heating the reactants at 150°-200°C. until hydrogen chloride is no longer evolved. These resins are said to form an inorganic ash or crust when heated in a flame, which makes them particularly useful in electrical insulation. Varnishes and lacquers containing them, it is claimed, give flame-resisting films. It is suggested that they be mixed with other resins, alkyds, for example, to give them flame-resisting characteristics.—*Paint Tech.*, 1943, 8, 85, p. 13.

INDIA'S MINERALS

In his presidential address to the recent Indian Science Congress meeting at Calcutta, Mr. D. N. Wadia described India's place in the world's mineral map. He said that the mineral outlook of the Indian region was on the whole satisfactory both for war- and peace-time requirements. India's resources in minerals of strategic importance, minerals for munitions and defence armaments, base metals, alloys, fluxes, refractories and accessory minerals could be regarded as adequate in several but not all of these classes. India was deficient, for example, in tin, tungsten, lead, zinc, nickel, graphite, and liquid fuels. But in the basic metals, iron, manganese, aluminium, and chromium, the country was well supplied; in the case of the first three, in large excess. India's neighbour, Burma, had abundant stocks of the munition metals of which India is in defect, while her oil resources must yet be regarded as considerable. Ceylon, Mr. Wadia pointed out, had reserves of the world's finest graphite. Ancillary minerals such as asbestos, cement, fertilisers, clays, mica, sulphur, various salts, ores and other minerals of industrial utility were available in quantities sufficient for the country's needs, while some were present in exportable surpluses.

Personal Notes

PROFESSOR R. G. W. NORRISH has been nominated as president of the British Association of Chemists for 1944.

MR. A. PREECE, M.Sc., has been appointed senior lecturer in metallurgy in the University of Leeds.

SIR LAWRENCE BRAGG, PROFESSOR C. G. DOUGLAS, and MR. R. O'F. OAKLEY, have been nominated by the D.S.I.R. to serve on the Council of the Gas Research Board as Government representatives.

DR. E. D. HUGHES, M.Sc., lecturer in chemistry at University College, London, has been appointed Professor of Chemistry at the University College of North Wales, Bangor.

CAPTAIN VICTOR SHEPERD has resigned from the board of Triplex Safety Glass, Ltd., and associated companies, and has been appointed a director of British Indestructo Glass, Ltd.

MR. H. H. DUNKIN, senior lecturer in metallurgy at the University of Melbourne, has been appointed acting Professor of Metallurgy during the temporary absence of Professor Greenwood on Government work.

MR. HARRY HEY, chief metallurgist of Electrolytic Zinc Co. of Australasia, Ltd., has been elected president of the Australasian Institute of Mining and Metallurgy for 1943.

SIR HAROLD HARTLEY has been appointed general treasurer of the British Association in succession to PROFESSOR P. G. H. BOSWELL, who has resigned after twelve years in office, first as a general secretary and then as general treasurer.

WING-COMMANDER GUY PERCIVAL GIBSON, who led the brilliant air attack on the Möhne and Eder dams, is the son of Mr. A. J. Gibson, who is well known to our readers as Special Officer, Lac Inquiry, India House, and as a leading authority on shellac matters generally.

MR. R. WARD, M.Sc. (Lond.), F.I.C., late of I.C.I. (Fertiliser & Synthetic Products), Ltd., Billingham, and former manager of the I.C.I. Ceramic Research Laboratory, has taken up a new appointment at the Royal Doulton Potteries, Lambeth, as General Development Manager.

MR. G. D. PRESTON, Senior Scientific Officer, National Physical Laboratory, has been appointed to the Harris Chair of Physics, University College, Dundee. Mr. Preston has been at the N.P.L. since 1921 and has been particularly interested in the study of metals and alloys by X-ray diffraction; recently, he has been concerned in the development of the electron microscope.

MR. ROBERT LARGE has been elected a director of English Clays Lovering Pochin & Co., Ltd., in place of the late Mr. A. C. Rouse.

Obituary

MR. JOHN TULLOCH, formerly manager of the Tharsis Sulphur and Copper Company, Hebburn-on-Tyne, has died at Sunderland, aged 79.

CORPORAL ROBERT G. DONALDSON, before the war a paper chemist with the Inveresk Paper Mills, has been reported missing, believed killed in action, in North Africa. Corporal Donaldson was 27, and joined up shortly after the outbreak of war.

MR. W. G. MESSENGER, B.Sc., F.I.C., died on May 2 at the age of 49. He was in charge of the section of the Lyons Laboratory dealing with the production of flavouring essences, on which matters his authority was recognised both on the Continent and in America. He had been associated with the Lyons Laboratory from its very beginning in 1919, when the staff comprised only Dr. Lampitt, Mr. Messenger, a laboratory junior, and a clerk.

New Control Orders

Edible Oils and Fats

The Minister of Food has revoked the Dripping and Edible Oils (Control of Sales) Order, 1942, and made a new order, to be known as the Edible Oils and Fats (Control of Sales) Order, 1943 (S. R. & O. 1943, No. 701). The effect of the new order is that all oils and fats (other than suet, peanut paste, and peanut butter) suitable for use in the manufacture of human food, may only be sold to, or bought by, a trade user under the authority of a permit issued by the Ministry. The order comes into force on May 24, 1943.

Explosives

By the Control of Explosives Order, 1943 (S. R. & O. 1943, No. 660), which came into force on May 10, further restrictions are imposed upon the keeping and sale of certain explosives. Gunpowder and safety fuse may not be kept elsewhere than at a licensed factory or licensed magazine without a licence from the police. The Order prohibits the purchase and sale of gunpowder and safety fuse except where the purchaser is duly licensed to acquire it or is the occupier of a licensed factory or licensed magazine, and the seller satisfies himself to that effect and keeps a record of the transaction. Similar restrictions are imposed on the transfer of most explosive substances otherwise than by way of sale (except legitimate transfers between persons in the same undertaking).

General News—From Week to Week

Lord Woolton expects that increased quantities of phosphates will now be received from Algiers.

The Board of Trade's concentration plan for the light castings industry in Scotland has been dropped.

Temporary organiser for the Microchemical Society, which is in process of formation, is Mr. B. Belcher, who invites anyone interested in this branch of chemistry to write to him at 85 Bannerdale Road, Sheffield.

It is announced that the 62nd annual meeting of the Society of Chemical Industry will be held at the Royal Institution on Friday, July 9, at 2.30 p.m. The Society's Medal will be presented to Dr. L. H. Lampitt.

A committee of five, under the chairmanship of Mr. E. V. Evans, has been set up to advise the Minister of Fuel on all questions of importance arising from the Ministry's relations with the gas industry, following the disbandment of the Directorate of Gas Supply. Mr. W. J. Smith is the secretary.

District Capacity Offices established by the Scottish Regional organisation of the Ministry of Production have been opened in Glasgow, Edinburgh, and Dundee, in order to ensure the best possible distribution of orders for war production throughout the Scottish industrial areas.

Delivering the Sir James Walker memorial lecture at Edinburgh on May 13, Dr. O. J. Walker emphasised the importance of Sir James's early work in electro-synthesis, and his interest in organic chemistry. He claimed that too little appreciation had been given to the work done in that sphere.

A review of "Plastics" was given by Dr. P. D. Ritchie and Mr. I. W. A. Kirkwood to the sixth meeting of the Association of Mining Electrical and Mechanical Engineers, in the Royal Technical College, Glasgow. With the aid of lantern slides, the speakers showed the development of the plastics industry in relation to its many new possibilities.

At the annual general meeting of the United Turkey Red Company, held recently in Glasgow, Mr. H. A. Holmes, the acting chairman, explained how the company had made its name, and derived much of its success, from the large-scale production of an article much in demand in Oriental markets. This demand, as well as export markets for other materials, had begun to shrink, and the company had now had to adapt itself to new conditions and create what was almost a new business, not without some success.

A new price-list of over 400 organic research chemicals has been issued by L. Light and Co., Ltd., Old Bowry Laboratories, Wraysbury, Bucks. Included among them are many compounds that have never yet been offered to research workers in this country.

A new association, entitled the Association of Boiler Setters and Chimney and Furnace Constructors, has been formed to represent the trade throughout the country and to establish relations with Government departments, etc. The chairman is Mr. P. A. Evans (W. Neil and Co., Ltd.), and the secretary is Mr. A. P. Hughes (The Outer Temple, 222 Strand, W.C.2).

The Board of Trade has decided that, for the period beginning June 3 and ending September 2, 1943, the rate of premium payable under any policy issued under the Commodity Insurance Scheme shall continue to be at the rate of 2s. 6d. per cent. per month. The monthly and three-monthly policies for a fixed sum and three-monthly adjustable policies previously issued will be continued.

Advocating an alteration to the patent laws, a correspondent of the *Manchester Guardian* suggests that if the buyer of a patent fails to market the line within, say, two years, the sole right of that patent should revert, without any consideration, to the original inventor. This, he says, would stop the old racket of buying patents competitive to a marketed line to keep the new idea off the market.

A re-issue of that well-known metallurgical textbook, *The Casting of Brass Ingots*, by R. Genders and G. L. Bailey, originally published in 1934, is being prepared by the British Non-Ferrous Metals Research Association. It is being reproduced by the photo-litho offset process, with all the original illustrations. The price is 21s. and orders may be placed with the Association or with any bookseller.

Foreign News

Superphosphate production in the U.S.A. during 1942 reached 5,144,484 tons, compared with 4,326,402 tons during 1941.

Phosphate deposits in Switzerland, large enough for an annual production of 100,000 tons of phosphoric acid, have been discovered on the eastern side of the Jura, near Ste. Croix.

The Compagnie Générale du Duraluminium et du Cuivre has been formed with a capital of 200 mill.fr. by the Compagnie Générale d'Electro-Metallurgie and Société du Duraluminium et de l'Aluminium Francais.

U.S. imports of Chile saltpetre amounted to 700,000 metric tons last year and more than twice that amount will be imported this year. Total exports of nitrate from Chile in 1941 was 1,397,550 tons.

Artificial fertiliser prices in U.S.A. have been held at 13 per cent. above pre-war level. Compared with the last war, when prices rose 86 per cent., this represents an annual saving to farmers of 194,000,000 dollars.

Producer gas has saved 16 million gallons of petrol in India, where 55 firms are now making plants, 10,000 civilian motors run on producer gas, and as many more are awaiting conversion.

The Gold Coast is to have an institute for arts and science near Achimota College. The Colonial Office announces a grant of £127,000 for its establishment under the Colonial Development Act.

Production of khaki uniforms and other fabrics for the U.S. Army is being speeded up by a new dyeing technique, which uses sodium chlorite instead of sodium dichromate for treating vat and sulphur dyes, which are noted for their fastness.

American chemists are to be enrolled as gas instructors in the U.S. Citizens Defence Corps. Where cities and counties are without a senior gas officer, local groups of chemists are invited to recommend suitable persons for the post.

Exports of antimony from Peru in the last quarter of 1942 were valued at 287,000 soles, as against nil in the corresponding quarter of 1941. In the same periods exports of petroleum derivatives increased from 19,458,000 to 26,766,000 soles, while crude petroleum fell from 4,347,000 to 588,000.

The Swiss paper *Weltwoche* reports that there is a shortage in Germany of the grease used for lubricating railway rolling stock and locomotives. This is an added blow to Germany's communication problems, caused by the systematic Allied bombing of factories, repair shops, and trains.

American corundum mines, which have been idle since 1918, may re-open. Mining of this mineral, with a hardness second to the diamond, flourished until 1905, when it succumbed to competition from carborundum, the artificial abrasive, and from imports. Big demands on the corundum supplies now come from the optical and grinding-wheel industries.

A new use for sulphuric acid has been found by the United States Forest Service. When tapping pine trees for resin, if the cut surfaces of the trees are treated with sulphuric acid, gum continues to flow from the wound for two weeks instead of one. The amount of resin and turpentine can thus be increased while the trees are not harmed in any way.

Plastic microscope cover slips are being made by a New York firm, Charles F. Hubbs and Co., who in their first year sold over a million. Formerly glass slips, which are normally one-two hundredth of an inch thick, had to be imported from Czechoslovakia and Japan.

Chemical fertiliser plant in Transnistria is to be built by "Azot," a company with a capital of 110 mill. lei, registered at Bucharest. German and Slovak firms are interested in the enterprise in addition to two Rumanian groups. The plant begins operations early in 1944.

A search for quartz crystals has been initiated by America's War Production Board, which appeals to residents of the Rocky Mountain States to locate deposits, offering $2000 a ton for perfect, water-clean material. The quartz crystals are needed for oscillators in radio sets.

Up to February 1, 1943, according to Mr. E. R. Stettinius, the U.S.A. had shipped to the U.S.S.R. more than 580,000 tons of steel, 46,000 tons of aluminium and duralumin, 21,500 tons of zinc, 94,000 tons of copper, nickel, and molybdenum, etc., 50,000 tons of toluol and TNT, and 75,000 tons of other chemicals had also been sent.

The ore-testing laboratory of the Denver Equipment Company of America finds that the samples sent for examination reflect the unusual demand for "critical" minerals. Out of every hundred samples received, 13 were of lead-zinc-copper ores with important values in gold and silver; other minerals with high percentages were fluorspar (10), manganese (9), tungsten (7), and titanium and zircon (5).

Food yeast as a substitute for meat protein is to be produced in Sweden, according to *The Anglo-Swedish Journal* (April, 1943). A factory for the production of food yeast from sulphite lye should be completed in three months time. Jointly run by the Cellulose Combine and Svenska Jastfabriks A/B, it will have a capacity of 10-20,000 tons of dry yeast a year. Two other factories are planned to produce a *Torula* yeast containing 50 per cent. of edible protein on a large scale.

Canada's 1943 production of industrial alcohol is estimated at 7,500,000 gallons, according to the Department of Munitions and Supply. It is not proposed to export any of this, but some imports are anticipated. In 1942, the Government purchased 2,000,000 gallons of industrial alcohol, the bulk of it made from molasses imported the previous year. The conversion price, paid to distillers, of 22 per cents. a gallon represented actual cost and a small profit. The molasses was obtained through the U.K. Sugar Board to reduce alcohol for use in plants working on U.K. orders.

Forthcoming Events

Mr. John Gloag will address the **Royal Society of Arts** on "The Influence of Plastics in Design," at 1.45 p.m., on **May 26.**

A joint meeting of the **Institute of Chemistry** with the **Newcastle Chemical Industry Club** will be held on **May 27**, at 6.45 p.m., at 18 Lovaine Place, Newcastle-upon-Tyne. An address on Plastics will be given by Dr. P. D. Ritchie.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

STEWARTS AND LLOYDS, LTD. (incorporated in Scotland). (M., 22/5/43.) April 30, charge by way of collateral security supplemented to Trust Deeds dated January 30 and June 14, 1934, etc.; charged on certain properties.

Company News

Selecta Chemical Products, Ltd., have changed their name to Invi Chemical Products, Ltd.

B. Laporte, Ltd., announce a dividend of 5 per cent., making 7½ per cent., tax free (same).

An interim ordinary dividend of 10 per cent. (same) has been declared by **Tube Investments, Ltd.**

An ordinary dividend of 15½ per cent., making 27½ per cent. (25 per cent.), for the year ended March 31, is being paid by **British Alkaloids, Ltd.** (manufacturers of T.C.P.).

Tunnel Portland Cement Ltd., announce a second interim dividend on the "A" and "B" ordinary stock of 12½ per cent., making 20 per cent. This is intended to be the total (same).

A good year was experienced by the **Rio Tinto Co., Ltd.,** during 1942, with the total revenue up from £494,117 to £616,077. No dividend is being paid on the ordinary shares, the last distribution on this class having been 20 per cent. for 1930.

The trading profit of the **Central Provinces Manganese Ore Company** for 1942, was £668,235 (£566,538). The final dividend on the 10s. ordinary shares was 15 per cent., tax free, again making 22½ per cent. for the year.

New Companies Registered

Advanced Patent Processes, Ltd. (380,446).—Private company. Capital: £100 in 100 shares of £1 each. Manufacturers of and dealers in chemicals, plastics, drugs, colours, dyes, etc. Directors: H. Reynell; Mrs. Harriet Smith. Registered office: 62 Oxford Street, W.1.

Teal and Holmes, Ltd. (380,556).—Private company. Capital: £1000 in 1000 shares of £1 each. Manufacturers of and wholesale and retail dealers in paints, colours, varnish, chemicals, glue, celluloid, tar, metal and wood preservatives, etc. Directors: E. Hardman; Mrs. Florence M. Teal. Registered office: Bedford Street, Wilmington, Hull.

A. V. S. Manufacturing Company (Preston), Ltd. (380,494).—Private company. Capital: £500 in 500 shares of £1 each. To acquire the business of manufacturing chemists carried on as the "A. V. S. Manufacturing Company," at Longton, near Preston. Directors: A. V. Sharples; Alma A. Sharples. Registered office: Howick Cross Depot, Liverpool Road, near Preston, Lancs.

Hutchinson (Ramsey), Ltd. (380,542).—Private company. Capital: £2500 in 2500 shares of £1 each. Manufacturers of and dealers in substances and products capable of being used in connection with the manufacture of plastics and phenolic condensation products, etc. Directors: W. C. Jones; E. H. Smith; W. M. Greener; A. J. Baron; W. J. Hutchinson. Registered office: Ramsey Mill, Chadderton, Lancs.

Chemical and Allied Stocks and Shares

THE prevailing tendency in the stock and share markets has again been to await the next major war development, and the volume of business in most classes of securities remained moderate. In accordance with the general tendency shares of chemical and kindred companies showed movements which on balance have not exceeded more than a few pence. Imperial Chemical at 38s. 7½d. were virtually the same as a week ago; the full results and the chairman's annual statement more than confirmed the good impression created by the preliminary statement for the past year's working. The current view is that, so far as can be judged, there are reasonable possibilities that the I.C.I. dividend will remain at 8 per cent. during the period of the war. B. Laporte kept at 78s. xd. on the 7½ per cent. tax free dividend, which

is equivalent to 15 per cent. gross, the same as the total payment for 1941. Awaiting the dividend announcement, Dunlop Rubber ordinary units had a fairly steady appearance around 35s. 3d. Lever & Unilever eased to 34s. 7½d., but on the other hand, Lever N.V. moved up to 31s. 6d.

At 15s. 7½d. General Refractories were slightly above the level of a week ago, while Imperial Smelting were again 14s. 6d. An improvement from 17s. 3d. to 17s. 9d. was recorded in Amalgamated Metal shares; in respect of the financial year to March 31, 1942, the dividend of the last-named company was reduced to 3½ per cent. The yield on this basis is small, but, as in many other instances, the shares are held firmly in the hope that, as time proceeds, dividends may recover after the war. Elsewhere, British Plaster Board 5s. ordinary units at 28s. 9d. were virtually the same as a week ago; the dividend announcement is due next month. British Aluminium showed a further improvement to 50s. 3d., and British Oxygen were maintained at 76s. 6d. At 39s. British Match held the improvement which followed publication of the financial results. Barry & Staines were little changed at 41s. 3d. and less active, the disposition being to await the dividend announcement, due in a few weeks. There was a further small improvement in Low Temperature Carbonisation shares, which are now quoted at their par value of 2s.

In other directions, Nairn & Greenwich held their recent rise to 67s. 6d., while although best prices recorded in the past few days were not maintained, Turner & Newall at 77s. were higher on balance. W. J. Bush ordinary continued very firmly held, but changed hands at 52s. 3d. at one time. Since 1938 the dividend of the last-named company has been 10 per cent., and in respect of 1941 this was very conservative, as 38 per cent. was earned on the shares; the past year's results are due in August. Tube Investments were 94s. " ex." the maintained interim dividend. British Glues & Chemicals 4s. ordinary changed hands at 7s. 6d. The dividend statement of the latter company can be expected in June. Among other smaller-priced shares, British Emulsifiers 2s. ordinary were 3s. 4½d., while Blythe Colour 4s. ordinary transferred up to 8s. 9d., and Lawes Chemicals at 12s. Greeff-Chemicals 5s. units were quoted at 7s. 6d. following the recent publication of the financial results and the maintenance of the dividend at 10 per cent. Elsewhere, Canning Town Glass were higher at 8s. 3d. on the improved results, while British Indestructo Glass were better at 4s. 6d. Triplex Glass were 32s.

Among other shares, Burt Boulton have transferred at close on 19s. at the time of writing. Fisons ordinary marked 48s. 6d. at one time, while there was a fair amount of activity up to 14s. 6d. in Goodlass Wall 10s. shares, awaiting the dividend announcement. Boots Drug were again 41s. 6d., and Southalls (Birmingham) have changed hands around 31s. Among plastics, British Industrial Plastics 2s. ordinary were 5s. 10½d., and Lacrinoid Products 4s. 4½d. A firmer tone prevailed among leading oil shares.

British Chemical Prices

Market Reports

CONDITIONS in most sections of the chemical market here are generally satisfactory from the point of view of the call for contract supplies and a moderate volume of new business is reported. Few price changes fall to be recorded and the undertone generally is firm with a slight tendency towards higher levels. In the soda products section good quantities of industrial refined nitrate of soda are moving into consumption, while caustic soda is being taken up steadily against contracts. Offers of yellow prussiate of soda are still restricted and values cover a wide range. A fair business is passing in soda ash and bicarbonate of soda, while chlorate of soda is a brisk market. There has been little change in conditions in the market for potash compounds. Quotations for permanganate of potash continue on a very firm basis and a fair trade is reported in acid phosphate of potash. The demand for solid caustic potash continues in excess of the quantities available. Among the miscellaneous products pressure for deliveries of borax and glycerine are well maintained and the demand for white powdered arsenic and British-made formaldehyde continues at a good level. There is nothing fresh to report from the coal-tar products market this week.

MANCHESTER.—Textile chemicals for the cotton, woollen, and allied trades have been fairly active sections of the Manchester chemical market during the past week and steady deliveries of a wide range of materials have been taken up against contracts. New buying from these as well as from other industrial users has been on a moderate scale, with the alkalis prominent among the products covered by the additional orders. Prices generally are on a stable basis, with a firm tendency in evidence throughout. Supplies of the leading tar products are finding a ready outlet both in the light and heavy sections.

GLASGOW.—There is no actual change in the position in the Scottish heavy chemical trade during the past week. Home business remains steady. Export trade is rather limited. Prices remain very firm.

Price Changes

Linseed Oil.—Crude, £50.
Rapeseed Oil.—Crude, £58.

Features in the movement of wholesale prices for April include the first rise in iron and steel prices for over a year and a fairly substantial increase in the index figure for chemicals and oils. The index for iron and steel rose 0.1 per cent. from 182.7 to 182.8 (1930 = 100), while the increase in chemical prices amounted to 0.8 per cent.—from 142.8 to 144.0. This last figure represents a rise of 7.2 per cent. during the year. A noteworthy factor was the increase of 13 per cent. in the price of varnish.

The Infestation Order, 1943, provides the Minister of Food with additional powers to deal with the infestation by rats, mice, insects, etc., of foodstuffs, materials, containers, vessels, premises and land. The Order provides for the notification in writing by the owner or occupier of infested premises or goods and for the issue of Directions prohibiting the use of infested premises, vessels, foodstuffs, or other articles until the infestation is remedied to the satisfaction of the Minister. To ensure an efficient standard of skill and service and to assist in the conservation of man-power and materials, pest control undertakers will be regulated by licence and the Minister may direct the methods to be employed and the substances to be prepared.

EDUCATIONAL

FOR SALE

The fact that goods made of raw materials in short supply owing to war conditions are advertised in this paper should not be taken as an indication that they are necessarily available for export.

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